COURSE STRUCTURE FOR M.TECH. ELECTRICAL ENGINEERING
SEMESTER II

w.e.f. 2013-2014

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
			L	T	P	C	Hrs/ wk	Theory			Practical		Total
								MS	ES	IA	LW	LE/Viva	Marks
1	EE 507	Modern Control Systems	3	0	0	6	3	30	60	10	--	--	100
2	EE 508	Power System Analysis and Dynamics	3	0	0	6	3	30	60	10	--	--	100
3	EE 509	Advanced Power Electronics	3	0	0	6	3	30	60	10	--	--	100
4	EE 510	Smart Grid Technologies and Applications	3	0	0	6	3	30	60	10	--	--	100
5	EE 511	Advanced Digital Signal Processing	3	0	0	6	3	30	60	10	--	--	100
6	EE 512	Laboratory-II	0	0	4	2	4	--	--	--	50	50	100
		Total	**15**	**0**	**4**	**32**	**19**	150	300	50	50	50	600

MS = Mid Semester, ES = End Semester; IA = Internal assessment (like quiz, assignments etc)
LW = Laboratory work; LE = Laboratory Exam

EE 507 Modern Control Systems										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **11**

ANALYSIS OF CONTROL SYSTEMS IN STATE SPACE: Concept of state and state space, state and output equations, state variable representations, canonical realizations, solution of state equations, Concepts of controllability and observability.

UNIT II **11**

STATE VARIABLE ANALYSIS OF DIGITAL CONTROL SYSTEMS: Discretisation of continuous time state equation, discrete time state equations, solution of discrete state space equations, Controllability to the origin and reachability.

UNIT III **17**

DESIGN OF MODERN CONTROL SYSTEMS: Pole placement design through state feedback, stability improvement by state feedback, state regulator design, Design of state observer and state estimator, Quadratic optimal regulator design, Model predictive control design.

TOTAL HOURS **39**

Text and References:

1 C.T.Chen, "***Linear system theory and design***", Oxford, 3rd Edition, 1999
2 K. Ogata, "***Modern Control Engineering***", PHI, 4th Edition, 2006
3 M. Gopal, "***Digital Control and State Variable Methods***", TMH, 3rd Edition,2009
4 John Bay, "***Fundamentals of linear state space systems***", McGraw Hill, 1998
5 Wilson Rugh, "***Linear system theory***", Prentice Hall, 2nd edition, 1996
6 Thomas Kailath, "Linear systems", Prentice Hall International
7 B.C.Kuo, "Automatic Control System".

EE 508 Power System Analysis and Dynamics										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **05**

NETWORK FORMULATION AND GRAPH THEORY: Introduction, Network Equations, Graph Theory, Development of Network Matrices from Graph Theoretic Approach, Augment Cut set Incidence Matrix Cut set and Circuit Equations, Building Algorithm for the Bus Impedance Matrix Modification of Z_{BUS} matrix due to changes in the primitive network

UNIT II **15**

GENERATOR MODELING - I (MACHINE VIEWPOINT): Classical Machine Description, Voltage Generation, Open-Circuit Voltage, Armature Reaction, Terminal Voltage, Power Delivered by Generator, Synchronizing Generator to an Infinite Bus, Synchronous Condenser, Role of Synchronous Machine Excitation in Controlling Reactive Power.

GENERATOR MODELING – II (CIRCUIT VIEWPOINT): Energy Conversion, Application to Synchronous Machine, The Park Transformation, Park's Voltage Equation, Park's Mechanical Equation, Circuit Model, Instantaneous Power Output, Applications, Synchronous Operation, Steady-state Model, Simplified Dynamic Model, Generator Connected to Infinite Bus (Linear Model).

UNIT III **12**

EXCITATION AND PRIME MOVER CONTROLLERS: Excitation System requirements, Elements of an Excitation System, types of Excitation System – AC/DC excitation, Static excitation system, Modelling of excitation system.

ANALYSIS OF SINGLE MACHINE SYSTEM: Small Signal Analysis with Block Diagram Representation, Characteristic Equation (CE) and Application of Routh-Hurwithz Criterion, Synchronizing and Damping Torque Analysis, Small Signal Model: State Equation, Nonlinear Oscillations – Hopf Bifurcation.

UNIT IV **07**

ANALYSIS OF MULTI-MACHINE SYSTEM: Simplified system Model, Detailed models: Case I, Detailed models: Case II, Inclusion of Load and SVC dynamics, Modal Analysis of Large Power Systems, Case Studies.

TOTAL HOURS **39**

Text and References:

1 Vijay Vittal, "***Power Systems Analysis***", Bergen, Pearson Education

2 K R Padiyar, "***Power System Dynamics***", B S Publications

3 P.Kundur, "***Power System Stability & Control"***, Tata Mcgraw hill

4 L. P. Singh, "***Advanced Power System Analysis and Dynamics",*** New Age International Ltd, New Delhi, 1992

EE 509 Advanced Power Electronics										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **08**

REVIEW OF POWER SEMICONDUCTOR DEVICES: Review of Power semiconductor devices, Gate and Base drive circuits - Preliminary design considerations, Temperature control of power devices.

DESIGN CONSIDERATIONS Design and selection of magnetic components, inductor, high-frequency transformers, line and EMI filters, Heat sink design, IEEE 519 (1992) considerations

UNIT II **12**

FLEXIBLE AC TRANSMISSION SYSTEMS: Principle of power transmission, Principle of shunt compensation, Shunt compensators: Thyristor controlled reactor, Thyristor switched capacitor, Static VAR compensator, Advanced static VAR compensator. Principle of series compensation, Series Compensators: Thyristor switched series capacitor, Thyristor controlled series capacitor, Force commutation controlled series capacitor, Series static VAR compensator. Principle of phase angle compensation, Phase angle compensator, Unified Power Flow Controller, Comparisons of compensators.

UNIT III **13**

Matrix Converter, Vector control, Indirect and direct vector control, various grid connected inverters, Multilevel inverters: Concept, Diode-Clamped, Flying-Capacitor, Cascaded type multilevel inverters, Features and comparison

UNIT IV **6**

APPLICATIONS OF POWER ELECTRONICS: Unity power factor conversion, Control of wind generators, active filters, photovoltaic applications, maximum power point tracking

TOTAL HOURS **39**

Text and References:

1 N.Mohan, T.M. Undeland & W.P.Robbins, "***Power Electronics: Converter, Applications & Design***", John Wiley & Sons, 1989

2 R. Bausiere & G. Seguier, "***Power Electronic Converters",*** Springer- Verlag, 1987

3 D.M.Mitchell, "***DC-DC Switching Regulator Analysis"***, McGraw Hill, 1987

4 B. Jayant Baliga, ***"Fundamentals of Power Semiconductor Devices"***, Springer,2008.

5 Web-Resources: *https://**ieee**xplore.**ieee**.org*

6 N.G.Hingorani & Gyugyi***, "Understanding Facts",*** Standard Publishers, 2001

7 K.R.Padiyar, ***"FACTS Controller in Power Transmission & Distribution",*** Anshan Ltd., 2009

EE 510 Smart Grid Technologies and Applications										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **08**

INTRODUCTION TO SMART GRID: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid ,CDM opportunities in Smart Grid

UNIT II **15**

SMART GRID TECHNOLOGIES: Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers, Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU)

UNIT III **06**

MICRO GRIDS AND DISTRIBUTED ENERGY RESOURCES: Concept of micro grid, need & applications of micro grid, formation of micro grid, issues of interconnection, protection & control of micro grid. Islanding, need and benefits, different methods of islanding detection.

UNIT IV **10**

POWER QUALITY MANAGEMENT IN SMART GRID: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

INFORMATION AND COMMUNICATION TECHNOLOGY FOR SMART GRID: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Broadband over Power line (BPL)

TOTAL HOURS **39**

Text and References:

1. Ali K., M.N. Marwali, Min Dai, "***Integration of Green and Renewable Energy in Electric Power Systems"***, Wiley
2. Clark W. Gellings, "***The Smart Grid: Enabling Energy Efficiency and Demand Response***", CRC Press
3. JanakaEkanayake, N. Jenkins, K. Liyanage, J. Wu, Akihiko Yokoyama, "***Smart Grid: Technology and Applications***", Wiley
4. Jean Claude Sabonnadiere, NouredineHadjsaid, "***Smart Grids***", Wiley Blackwell
5. Tony Flick and Justin Morehouse, "***Securing the Smart Grid***", Elsevier Inc.
6. Peter S. Fox-Penner, "***Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities***", Island Press